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**The daily relationships between staffing, safety perceptions and personality in
hospital nursing: A longitudinal on-line diary study**

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ABSTRACT

Background The association between poor staffing conditions and negative patient safety consequences is well established within hospital nursing. However, many studies have been limited to nurse population level associations, and have used routine data to examine relationships. As a result, it is less clear how these relationships might be manifested at the individual nurse level on a day-to-day basis. Furthermore, personality may have direct and moderating roles in terms of work environment and patient safety associations, but limited research has explored personality in this context.

Objective To further our understanding of these associations, this paper takes a within-person approach to examine nurses' daily perceptions of staffing and patient safety. In addition, we explore the potential role of personality factors as moderators of daily level associations.

Method We recruited eighty-three hospital nurses from three acute NHS Trusts in the UK between March and July 2013. Nurses completed online end-of-shift diaries over three-five shifts which collected information on perceptions of staffing, patient-nurse ratio and patient safety (perceptions of patient safety, ability to act as a safe practitioner, and workplace cognitive failure). Personality was also assessed within a baseline questionnaire. Data were analysed using hierarchical linear modelling, and moderation effects of personality factors were examined using simple slopes analyses, which decomposed relationships at high and low levels of the moderator.

Results On days when lower patient-nurse ratios were indicated, nurses reported being more able to act as a safe practitioner ($p = .011$) and more favourable perceptions of patient safety ($p = <.001$). Additionally, when staffing was perceived more favourably, nurses reported being more able to act as a safe practitioner ($p = <.001$), more favourable perceptions of patient safety ($p = <.001$) and experienced less workplace cognitive failure ($p = <.001$). Conscientiousness and emotional stability emerged as key moderators of daily level associations between staffing and patient safety variables, with many relationships differing at high and low levels of these personality factors.

Conclusion The findings elucidate the potential mechanisms by which patient safety risks arise within hospital nursing, and suggest that nurses may not respond to staffing conditions in the same way, dependent upon personality. Further understanding of these relationships will enable staff to be supported in terms of work environment conditions on an individual basis.

Keywords: Nursing; staffing; patient safety; personality; diary

INTRODUCTION

Nurse staffing and patient safety

The association between a poor work environment and negative patient safety consequences is well established within hospital nursing.¹⁻⁴ Great emphasis has been placed on nurse staffing for patient safety and quality outcomes from a research⁵⁻⁸ and a policy perspective.⁹⁻¹¹ However, many studies have been limited to cross-sectional methods (e.g.,^{5 12 13}). As a result, the majority of existing findings are based on group level associations and often use routine data to examine relationships (e.g., nurse reported staffing levels linked with mortality data), so it is less clear how these relationships might be manifested at the individual nurse level on a day-to-day basis.

Relationships established at a between-person level may differ from associations established at the individual daily level.¹⁴ Research representing relationships based on nurse group level associations do not tell us how work environment factors impact on any individual nurse on a day-to-day basis, bearing in mind that nurses may react differently to similar pressures. Research that furthers our understanding of relationships at the individual daily level is paramount, as in theory interventions based on studies reporting nurse group level associations, might actually make things worse for some nurses. Given that many of the usual approaches of measuring staffing and patient safety would be inappropriate at an individual daily level, we focused on “perceptions” of both staffing and patient safety in this study.

There is also a distinct lack of research involving European or UK nurses which attempts to understand associations between features of the hospital work environment and patient outcomes, with many studies limited to nursing samples in the United States (US).¹⁵ Indeed, it is recognised that the research available to guide policy and practice for safe nurse staffing is lacking in Europe.¹⁶ Recent findings from the RN4CAST study,¹⁷ one of the largest nursing workforce studies ever conducted in the European Union, demonstrate the importance of a better nurse work environment (e.g., in terms of managerial support, doctor-nurse relations) for nurse reported care quality and patient safety, and patient reported satisfaction,¹⁵ and

report an increase in nurses' workload to be associated with the likelihood of inpatient hospital death.¹⁶

Personality and patient safety

Another potentially important gap in the literature is the study of individual differences (e.g., personality). Whilst this has been neglected in the literature to date, it is intuitive that personality factors may have both direct and moderating roles in terms of associations between the work environment and patient safety within hospital nursing. The five-factor model of personality encompasses dimensions of personality: extraversion, agreeableness, conscientiousness, neuroticism (emotional stability), and openness to experience (intellect/imagination).¹⁸ Evidence from outside a healthcare context demonstrates associations between conscientiousness and job performance,¹⁹⁻²¹ team performance^{22 23} and accident involvement.²⁴ Emotional stability has been highlighted as a predictor of job performance,²⁵⁻²⁷ and agreeableness established as a predictor of work accidents²⁸ and job performance.²⁷ There is also some cross-sectional evidence in support of an association between emotional stability and quality and safety,²⁹ and patient perceptions of care quality.³⁰

This literature reinforces the need to consider personality in terms of patient safety within a healthcare context. Cross-sectional associations with patient safety have been demonstrated for specific personality factors i.e., emotional stability,²⁹ but to our knowledge, no research has investigated all five personality factors in the same study using a comprehensive measure of personality, nor have personality factors been explored as potential moderators of daily work environment and patient safety relationships. If we are able to understand the role of personality, this may enable health service providers to support nurses more effectively, and better manage patient safety.

Theoretical framework

This study is not grounded within a single theory, due in part to this being an emergent area of research. A dominant theoretical perspective within patient safety research is the systems approach to human error,³¹ which provides the theoretical basis for the variables

included in this study. The basic tenet of the systems approach is that changes in one part of the system will have repercussions on another part of the system, and defences, barriers, and safeguards are key components of this approach. The systems approach proposes that errors can be understood as an interaction between active failures – conceptualised as unsafe acts committed by people who are in direct contact with the patient or system – and more system based organisational weaknesses, referred to as latent conditions. Error is said to occur as a result of the interaction between these components. This system-wide view of causation has meant that system-based patient safety research has traditionally focused on latent conditions (e.g., management of staffing) and local conditions (e.g., staff-patient ratios, skill-mix), rather than active failures (e.g., slips, lapses, mistakes). Therefore, focusing on factors at the individual nurse level affords us the opportunity to capture potential proxies of active failures. Measuring cognitive failure, which relates to failures in perception, memory, and motor function,³² may prove useful here, with associations between job characteristics and workplace cognitive failures,³³ and workplace cognitive failure and rate of patient safety incidents³⁴ previously established in nursing. Thus, in addition to perceptions of safety, daily workplace cognitive failure experienced was also included as an outcome variable in this study. Moreover, it is less clear how individual differences fit into the systems approach. Therefore, we have attempted to extend theory by exploring personality in the context of nurse staffing and patient safety.

Key contributions of the research

Evidently, important questions remain unanswered, including i) how are staffing and patient safety outcomes associated for individual nurses on a daily basis? and ii) are these associations variable at the individual nurse level as a function of personality?

Methodological designs termed “within-person approaches” are relatively new to nursing research^{35 36} and may be beneficial to address these questions as they enable comparisons in terms of how individuals respond to contextual factors, by collecting data repeatedly within the natural environment using daily diary methods.³⁷ There are many advantages of a within-person diary approach, for example, exploring relationships at the daily level aims to reduce

the amount of retrospective bias^{14 38} compared to single reports where participants recall their experiences (e.g., cross-sectional survey). Consequently, ecological validity may be increased, as recollection is temporally close to the experience.³⁹

Another advantage of this approach is the associated analyses (multi-level modelling) which enables the investigation of within-person variability together with between-person factors.^{40 41} Analyses that focus on differences between group-level averages do not consider the hierarchical structure of the data and may obscure, or even contradict, the nature and direction of relationships between variables at an individual level.¹⁴ If we are to be able to develop robust interventions to support nurses and improve the safety and quality of care, we need to better understand how the work environment impacts on individuals, not just the average impact on groups of individuals.

To summarise, this study adopted a within-person diary approach to examine associations between daily staffing and safety perceptions at the individual level, within a sample of hospital nurses over a three-five shift period. In addition, the study explored the potential moderating role of personality in relation to these associations. It is hypothesised that these daily relationships will differ dependent upon personality factors.

Research questions

- 1) Are nurses' daily perceptions of staffing associated with daily safety perceptions?
- 2) Do personality factors moderate relationships between nurses' daily perceptions of staffing and daily safety perceptions?

MATERIALS AND METHODS

Participants

Hospital nurses from three acute NHS Trusts in the UK were recruited to the study between March and July 2013. Ninety-five participants completed baseline measures, 77 participants completed three or more end-of-shift diaries, 83 participants completed two end-of-shift diaries, and 89 participants completed one end-of-shift diary. A MANOVA conducted with age, gender, length of time qualified and the five personality factors as dependent

variables, and completion as the independent variable, was non-significant ($F(8, 86) = .76, p = .63$). The mean age of the baseline sample was 36.74 years (range=21–59 years), 91% of the participants were female, and 67% indicated their ethnicity as White British. In terms of education, the majority of nurses recorded their highest nursing qualification as degree (47%), followed by masters (11%), diploma (27%), and registered general nurse (13%).

Design

Taking an interval-contingent approach, participants completed diaries at the end of each shift for a minimum of three (preferably consecutive) shifts. We took this approach, rather than an event-contingent approach where assessments are recorded after a pre-specified event, as reduced burden has been shown to increase participant compliance.⁴² This approach was also preferred in a feasibility focus group conducted with nurses from multiple clinical areas and job roles, with ranging levels of seniority to explore issues around the study method and measures. Furthermore, for the variables of interest we deemed reflections at the end-of-shift appropriate as it is unlikely they would vary greatly throughout a shift. In the majority of cases nurses completed the end-of-shift diaries over consecutive shifts; however, some nurses had more complicated shift patterns which were not on consecutive days. The study received ethical approval from the University of Leeds, School of Psychology Ethics Committee, and appropriate governance approvals were sought for each research site. The content presented in the current paper was part of a wider study, with other variables measured that are not reported here.

Procedure

Nursing staff from a range of clinical areas were invited to participate via study information distributed to staff ward areas, which provided the web address for study sign-up, and a study advert was also cascaded to nurse managers via email. As an incentive, participants were offered a £10 shopping voucher to participate. Following sign-up, participants completed a pre-diary survey and indicated the date, start and finish times for

the shifts they would be completing the end-of-shift diaries. Participants received automatic emails containing the web-link to complete diary entries on the specified dates and shift end time, in addition to text message reminders if they had provided their mobile telephone number. An in-house software package administered the pre-diary survey and end-of-shift diaries.

Measures

Pre-diary survey

Personality

Personality was assessed using a 50-item measure,⁴³ which measures the 'Big-Five' factors: extraversion, agreeableness, conscientiousness, emotional stability (neuroticism), and intellect and imagination (openness to experience). Participants indicated their level of agreement to statements as a description of themselves on a 5-point rating scale (1 = very inaccurate to 5 = very accurate). For the factor extraversion an example statement included 'Am the life of the party' ($\alpha = .87$), for agreeableness 'Feel little concern for others' ($\alpha = .75$), conscientiousness 'Make a mess of things' ($\alpha = .78$), emotional stability 'Worry about things' ($\alpha = .85$), and finally intellect/imagination 'Have a rich vocabulary' ($\alpha = .63$).

Demographic information

Information pertaining to age, length of time as a fully qualified nurse, and gender was recorded within the pre-diary survey.

End-of-shift daily measures: Staffing

Perceptions of staffing

A measure from the Agency for Healthcare Research and Quality (AHRQ), Hospital Survey on Patient Safety Culture (HSOPC)⁴⁴ was amended to collect this information in relation to 'this shift'. Participants responded to four items, and indicated their level of agreement to statements about their work area/unit on a 5-point rating scale (1 = strongly disagree to 5 = strongly agree). An example statement included 'This shift we worked in

"crisis mode" trying to do too much, too quickly'. Higher scores indicated better perceptions of staffing ($\alpha = .73$).

Patient-nurse ratio

To measure patient-nurse ratio for an individual nurse for a shift, participants responded to the following question: 'On this shift how many patients were allocated under your direct care?'. The phrasing of this question was considered at the feasibility focus group, and there was consensus that it was an appropriate assessment of patient-nurse ratio at a daily level.

End-of-shift daily measures: Safety perceptions

Perceptions of patient safety

A measure from the AHRQ HSOPC⁴⁴ was amended to collect this information in relation to 'this shift'. Perceptions of patient safety were assessed using four-items, and participants indicated their level of agreement to statements about their work area/unit 'this shift' on a 5-point rating scale (1 = strongly disagree to 5 = strongly agree). An example statement included 'This shift patient safety was never sacrificed to get more work done'. Higher scores indicated better perceptions of patient safety ($\alpha = .83$).

Workplace cognitive failure

The Workplace Cognitive Failure Scale (WCFS)⁴⁵ was amended to collect this information in relation to 'this shift'. This 15-item self-report measure assesses failures in perception, memory, and motor function. Participants were asked to indicate how often these things happened to them 'this shift' using a 5-point rating scale (0 = never to 4 = very often). An example statement included 'Did not fully listen to instruction?'. Higher scores were indicative of experiencing more workplace cognitive failure ($\alpha = .90$).

Safe practitioner measure

Due to the novel methods used in this study to explore daily relationships, there were no suitable measures of perceptions of safety available in the existing literature, at the level of the individual practitioner i.e., not at the level of work area/unit. Therefore, we developed a

one-item measure to capture how well nurses felt they were able to act as a safe practitioner taking the conditions on that particular shift into account. There was consensus at the feasibility focus group that this item was an appropriate assessment of perceived safety at the individual nurse level. To measure the extent nurses felt they were able to act as a safe practitioner on shift, dependent upon conditions, participants responded to the following statement on a 5-point rating scale (1 = strongly disagree to 5 = strongly agree), 'My practice was not as safe as it could be because of work related factors/conditions on this shift (e.g., staffing, patient factors, teamwork)'. This item was recoded so higher scores represented a more favourable perception of safety.

Data preparation

Before analysis, all variables were screened for outliers by inspecting boxplots and computing z-scores (z score of >3.29 considered an outlier). In the level 1 data file there were two instances where the patient-nurse ratio was not a feasible/realistic number (too high), therefore these scores were adjusted to the mean plus two standard deviations.⁴⁶

Data analysis

We analysed the data using hierarchical linear modelling (HLM) and HLM6.⁴⁷ This type of analysis can be used to assess nested data structures with relationships within a particular hierarchical level being analysed simultaneously with relationships between hierarchical levels.^{40 41} Although we do not know the specific reasons some participants did not complete a minimum of three end-of-shift diaries, participants who had completed two or more end-of-shift diaries were included in the analyses, as removing these participants would reduce the power of the models.¹ The data contained a two-level hierarchical structure, at level 1 the within-subject variation (e.g., perceptions of staffing and safety

¹ When participants (n = 6) who completed only two end-of-shift diaries were removed from the analyses, all findings were unchanged.

perceptions) and at level 2 the between-subject variability (e.g., personality).² Level 1 predictor variables were centered around the group mean, and the level 2 personality factors were centered around the grand mean.⁴⁸⁻⁵⁰ At level 2, age and length of time qualified were centered around the grand mean, and gender was uncentred. Little's chi-square statistic for testing whether values are missing completely at random (MCAR)⁵¹ was not significant for the level 1, nor the level 2 data files, demonstrating that there was no systematic pattern to the missing values in the data sets. Missing data in the level 1 file were replaced with the person mean for that item, and in the level 2 file, missing data were replaced with the column mean. Gender, age and length of time qualified were entered as control variables in all analyses to account for possible influences of these demographic characteristics.

The level 1 slope (models) were examined to test the relationships between perceptions of staffing, patient-nurse ratio and safety perceptions. We also explored the cross-level effect of whether the staffing, patient-nurse ratio and safety perception relationships (level 1) were moderated by personality factors (level 2). The general form of the model is expressed by the following equation:

$$\text{Outcome variable} = \beta_{00} + \beta_{01} (\text{Gender}) + \beta_{02} (\text{Age}) + \beta_{03} (\text{length of time qualified}) + \beta_{04} \\ (\text{e.g., conscientiousness}) + \beta_{10} (\text{e.g., perceptions of staffing}) + \beta_{11} \\ (\text{e.g., conscientiousness} \times \text{e.g., perceptions of staffing}) + \epsilon$$

β_{00} = Mean level of outcome variable

β_{01} = Indicates the extent to which this average is influenced by gender

β_{02} = Indicates the extent to which this average is influenced by age

β_{03} = Indicates the extent to which this average is influenced by length of time qualified

β_{04} = Indicates the extent to which this average is influenced by level of personality factor (e.g., conscientiousness)

β_{10} = Indicates the extent to which this average is influenced by level of staffing variable (e.g., perceptions of staffing)

² The intra-class correlation coefficient (ICC) for the outcome variables were as follows: perceptions of patient safety .42; safe practitioner .23; workplace cognitive failure .66.

β_{11} = Indicates the extent to which this average is conditional on the level of personality factor (e.g., conscientiousness)

ε = Error term

We examined significant cross-level interactions, where a personality factor was found to moderate a perceptions of staffing or patient-nurse ratio—safety perception relationship, using simple slope analyses.⁵² Significant moderation effects were decomposed for higher (+1SD) and lower (-1SD) levels of the moderator. The influence of each personality factor was explored separately as examining personality factors simultaneously would reduce the power of the models.³

RESULTS

Descriptive statistics

The descriptive statistics for all study variables are presented in Table 1. A total of 324 diary days were completed for 83 participants, the mean number of diaries completed was 3.9, and the mean shift end time across the study period was 17:24 (median 19:00).

³ When controlling for the other personality factors in the moderator analyses the results were unchanged, except for the emotional stability x patient-nurse ratio – safe practitioner relationship which moved from marginally significant ($p = .050$) to not significant ($p = .080$). Therefore, this relationship should be interpreted with caution.

Table 1 Descriptive statistics for level 1 (end-of-shift) and level 2 (between-subject) variables across the study period

	Mean	SD	Min	Max
Level 1 variables				
Patient-nurse ratio	9	8	0	40
Perceptions of staffing	15.23	3.37	5	20
Workplace cognitive failure	23.06	7.69	14	51
Safe practitioner	4.02	1.10	1	5
Perceptions of patient safety	16.31	3.22	7	20
Level 2 variables				
Age	36.74	10.52	21	59
Length of time qualified (months)	140.61	117.40	6	444
Personality factors				
Conscientiousness	39.13	5.37	27	50
Agreeableness	42.55	4.44	30	50
Intellect/imagination	35.02	4.41	26	45
Extraversion	33.04	7.18	11	48
Emotional stability	33.14	7.12	16	47

Note. SD, standard deviation.

Perceptions of staffing, patient-nurse ratio and safety perception relationships

The findings for the level 1 models (Appendix 1: Table 2), demonstrated significant associations between patient-nurse ratio, perceptions of staffing, and the safety perception outcomes (β_{10}). On shifts when participants indicated lower patient-nurse ratios they reported more favourable perceptions of patient safety for the unit, and being more able to act as a safe practitioner taking due to conditions on shift. Furthermore, when participants perceived staffing on a shift more favourably, they reported more favourable perceptions of patient safety for the unit, being more able to act as a safe practitioner due to conditions on shift, and also reported experiencing less cognitive failure.

Personality factors and staffing—safety perception relationships

These analyses were carried out for each of the personality factors separately, and revealed that personality factors moderated many of the relationships between perceptions of staffing, patient-nurse ratio and safety perception outcomes (Appendix 2: Table 3). Notably, extraversion did not moderate any of the daily relationships. Furthermore, none of the personality factors moderated the relationships between patient-nurse ratio and perceptions of patient safety, and perceptions of staffing and workplace cognitive failure.

Patient-nurse ratio

Intellect/imagination and safe practitioner outcome

Simple slope analyses showed that for lower levels of intellect/imagination (-1SD) there was no significant association between patient-nurse ratio and the safe practitioner outcome ($\beta = .000$, $p = .94$). However, for higher (+1SD) levels of intellect/imagination, the relationship was significant ($\beta = -.053$, $p = <.001$). This significant negative association indicates that on days when patient-nurse ratios were lower, nurses high on intellect/imagination reported higher ratings on the safe practitioner outcome. This moderation effect and associated slope values are depicted in Figure 1.

Emotional stability and safe practitioner outcome

Although this relationship was marginally significant, it was in the same direction as the main analyses. For that reason, we conducted follow up simple slopes analysis, which showed that for lower levels of emotional stability (-1SD) there was no significant association between patient-nurse ratio and the safe practitioner outcome ($\beta = -.000$, $p = .88$). However, for higher (+1SD) levels of emotional stability, the relationship was significant ($\beta = -.003$, $p = .004$). This significant negative association indicates that on days when patient-nurse ratios were lower, nurses high on emotional stability reported higher ratings on the safe practitioner outcome. This moderation effect and associated slope values are depicted in Figure 2.

Conscientiousness and workplace cognitive failure outcome

Simple slope analyses showed that for lower levels of conscientiousness (-1SD) there was a significant positive association between patient-nurse ratio and workplace cognitive failure ($\beta = .172$, $p = .025$), indicating that on days where the patient-nurse ratios were lower, nurses low on conscientiousness experienced less workplace cognitive failure. For higher (+1SD) levels of conscientiousness, the negative association established was not significant ($\beta = -.083$, $p = .29$). This moderation effect and associated slope values are depicted in Figure 3.

Perceptions of staffing

Agreeableness and safe practitioner outcome

The positive relationship between staffing perceptions and the safe practitioner outcome was significant at both high (+1SD) ($\beta = .139$, $p = <.001$) and low (-1SD) ($\beta = .245$, $p = <.001$) levels of agreeableness. This significant positive association indicates that on days when staffing perceptions were higher, nurses both high and low on agreeableness reported higher ratings on the safe practitioner outcome. For lower (-1SD) levels of agreeableness, the association between staffing and the safe practitioner outcome was stronger compared to those higher in agreeableness. This moderation effect and associated slope values are depicted in Figure 4.

Emotional stability and perceptions of patient safety outcome

The positive relationship between staffing perceptions and the perceptions of patient safety outcome was significant at both high (+1SD) ($\beta = .666$, $p = <.001$) and low (-1SD) ($\beta = .409$, $p = <.001$) levels of emotional stability. This significant positive association indicates that on days when staffing perceptions were higher, nurses both high and low on emotional stability reported higher perceptions of patient safety. For higher (+1SD) levels of emotional stability, the association between staffing and perceptions of the patient safety outcome was stronger compared to those with lower emotional stability. This moderation effect and associated slope values are depicted in Figure 5.

Conscientiousness and safe practitioner outcome

The positive relationship between staffing perceptions and the safe practitioner outcome was significant at both high (+1SD) ($\beta = .151$, $p = <.001$) and low (-1SD) ($\beta = .226$, $p = <.001$) levels of conscientiousness. This significant positive association indicates that on days when staffing perceptions were higher, nurses both high and low on conscientiousness reported higher ratings on the safe practitioner outcome. For lower (-1SD) levels of conscientiousness, the association between staffing and the safe practitioner outcome was stronger compared to those with higher levels of conscientiousness. This moderation effect and associated slope values are depicted in Figure 6.

DISCUSSION

This paper presents findings from a study which administered a daily diary to hospital nursing staff from multiple clinical areas, across three acute NHS Trusts in the UK. The findings add to the existing literature in three important ways – first, by establishing daily level associations between nurse staffing perceptions and perceptions of safety; second, by highlighting the relevance of personality; and, third we have contributed to theory by exploring individual differences in this context.

This study demonstrates for the first time, that relationships between nurses' perceptions of staffing and patient safety vary day-to-day, in the direction we might expect. Specifically, on shifts when staffing was perceived more favourably, patient safety for the work area/unit was also perceived more favourably, nurses reported being more able to act as a safe practitioner, and experienced less cognitive failure. Furthermore, on shifts when nurses indicated lower patient-nurse ratios, higher perceptions of patient safety were reported for the unit, and nurses reported being more able to act as a safe practitioner. The findings are consistent with the wealth of research which has evidenced the relationship between staffing and patient safety outcomes (e.g. ⁵ 53-56).

Recently there have been calls to implement mandated staffing ratios in the UK. The Royal College of Nursing (RCN) have published numerous reports advocating mandated

staffing levels, including a policy position published in 2010 which detailed the challenges associated with identifying optimal levels and mix of nurse staffing.¹⁰ In 2012, another RCN report echoed this standpoint, concluding that it is now time to set more clearly defined standards, and mandatory staffing levels must be adopted by providers, regulators and commissioners of health services.¹¹ Our findings reinforce the importance of adequate nurse staffing, and demonstrate that perceptions of staffing and patient-nurse ratios affect nurses' perceptions of their ability to deliver safe care day-to-day, as well as their perception of the safety of their ward/unit. Therefore, nurses' perceptions of staffing at the daily level over a short period of time might be sensitive enough to predict when patient safety vulnerabilities and/or threats may arise, potentially supporting services to manage safety proactively.

What is unique to this study is the diary design and the associated analysis (hierarchical linear modelling), which allowed us to link nurses' perceptions of staffing to safety perceptions for that same shift, with associations based on measures at the individual nurse level. Focusing more generally on perceived safety variables (as opposed to objective indicators of safety), meant that we could measure these perceptions of the work area/unit, perceived safety of the individual, and workplace cognitive failure experienced. Furthermore, there are established associations between safety culture and patient outcomes,⁵⁷⁻⁶⁰ and evidence to support the relationship between experiencing a higher level of cognitive failure and a higher rate of patient safety incidents.³⁴ Hence, there is strong evidence to support focusing on perceived safety and experience of workplace cognitive failure, as potential proxies for more objective safety related indicators.

The recognition of the relevance of personality in this context is the second significant contribution of this work. Two key personality factors emerged as being particularly important – conscientiousness and emotional stability, and for brevity, we will be focussing our attention more so on these factors. Notably, extraversion did not moderate any of the daily relationships. However, this is not particularly surprising given that although extraversion has been associated with job performance, it is considered to have a weaker relationship with performance compared to conscientiousness and emotional stability.¹⁹

Nurses both high and low on conscientiousness reported being more able to act as a safe practitioner on days when staffing was perceived more favourably, although this relationship was more pronounced in nurses low on conscientiousness. Additionally, nurses low on conscientiousness reported experiencing less workplace cognitive failure on days when they had fewer patients under their care. In contrast, this relationship was not established in nurses high on conscientiousness. These findings suggest a potential protective quality of being high on conscientiousness, in effect buffering the negative consequences of poor staffing on patient safety perceptions. This lends support to previous research from the job performance literature, where conscientiousness has been found to be predictive of job performance across occupations,¹⁹⁻²¹ associated with safety related job outcomes⁶¹ and accident involvement.²⁴

An association between daily patient-nurse ratio and daily workplace cognitive failure experienced was not established in nurses high on conscientiousness, which is noteworthy as in previous research within nursing a negative association has been established between conscientiousness and workplace cognitive failure.³³ Taken together, these findings suggest that nurses low on conscientiousness may need more support to facilitate their skills in workload management, to help them manage and deal with their workload on days when staffing is perceived as being poorer.

For emotional stability, whilst nurses both high and low on emotional stability reported more positive perceptions of patient safety on days when staffing was perceived more favourably, this relationship was more pronounced in nurses high on emotional stability. Furthermore, nurses high on emotional stability reported being more able to act as a safe practitioner on days when they had less patients under their care, but this relationship was not established for nurses low on emotional stability. Common traits associated with low emotional stability include being anxious, depressed, angry, embarrassed, emotional, worried, and insecure, in comparison, individuals who are high emotional stability tend to be secure and calm.⁶² We might expect nurses high on emotional stability to be affected by anxieties associated with work environment factors to a lesser extent. The current findings

for emotional stability are interesting, and not necessarily in the direction we might intuitively expect. One possible explanation is that nurses high on emotional stability are more able to accurately perceive the potential negative safety consequences arising as a result of higher patient load and poorer staffing conditions, at the work area/unit level and at the individual level. Whereas for nurses low on emotional stability, a positive association between perceived safety and staffing levels, was only evident for measures relating to the work area/unit. When focussing on staffing and safety variables specifically relating at the individual level i.e., patient-nurse ratio and safe practitioner outcome, nurses low on emotional stability seem to be unaffected.

The findings broadly support previous research which established a positive association between nurse emotional stability and nursing care quality,³⁰ and patient safety.²⁹ One potential mechanism for these associations is that nurses high on emotional stability perceive changes in their work environment along the lines you would expect, that is – when staffing is perceived more favourably, so is patient safety. However, as this is the first study of its kind to explore the potential moderating role of personality in this context, and this area of research is very much in its infancy, additional work is essential to build upon these findings to further understand the role of personality. Nevertheless, our findings highlight that nurses might not respond in the same way to work environment pressures and conditions, and individual nurses may be more or less vulnerable to patient safety risks.

Finally, although the aim of this study was not to test constructs of a specific theory or model, the systems approach³¹ provided the broad theoretical basis for the study. We have contributed to theory by demonstrating that individual differences such as personality, may interact with system level factors i.e., latent failures (e.g., management of staffing) and local conditions (e.g., patient-nurse ratio) to influence perceptions of safety and the experience of workplace cognitive failure, viewed as a potential proxy of active failure in this study.

Limitations

It is important to acknowledge the limitations of this study. Firstly, the number of end of shift diaries each nurse completed was limited to between three and five. Secondly, nurses self-selected into the study on an individual basis, a stronger approach would be to recruit nurses from the same wards, working on the same shifts, as this would enable comparisons within and between wards. Thirdly, as our focus was on understanding associations at the individual nurse level, specifically perceptions of staffing and safety, we were limited to self-report measures. Finally, as we recruited participants into the study opportunistically, we were unable to calculate a response rate.

Implications

Given the dominance of the systems approach, an important question arising from this study is, should we re-embrace the individual in the context of patient safety? Our findings highlight the need for nurses to be supported on an individual basis as nurses might not respond to work environment pressures in the same way. Therefore, we need to revisit how individuals work within the system, as system level changes may impact on individuals differently. Although further work is required to replicate these associations in larger samples, a useful starting point would be to encourage staff to become aware of the conditions under which they might be most vulnerable to patient safety risks arising. Secondly, if supervisors/managers are aware of how staff may respond differently to the same work environment pressures, this will allow them to tailor support accordingly.

Increased emphasis is being placed on values based recruitment (VBR) into nursing.^{63 64} Although personality and values are separate constructs,⁶⁵ Health Education England have published a VBR framework⁶⁶ which suggests that personality assessment may be useful at the attraction phase of recruitment. For example, personality assessment may help candidates self-select in terms of values, as well as informing questions at interviews, as opposed to being used as stand-alone instruments. In our study, the intent behind examining the role of personality in the context of patient safety was to add to the

evidence base exploring how we can better support nurses, as opposed to highlighting 'risky' personality profiles for nursing. However, if recruitment into nursing is moving towards this more targeted approach, our findings contribute to the drive for a more in-depth recruitment process into nursing, by highlighting conscientiousness and emotional stability as particularly important in terms of patient safety. Furthermore, exploring the relevance of personality in this context helps us to understand whether there are personality factors that buffer against negative patient safety consequences arising as a result of poor work environment conditions.

Future research

To further our understanding of these associations, within-person ward based studies, which assess multiple professional groups (e.g., nurses, doctors, health care assistants) from the same ward, working on the same shifts, are advocated. Taking this approach would allow us to examine whether staff working on the same shift perceive staffing and patient safety in the same way, as well as exploring potential differences in these associations between professional groups. Furthermore, to address one of the limitations of this study, future studies should endeavour to replicate these types of study over longer study periods to enable lagged effects to be examined, which would enable us to explore how these perceptions are related to objective/clinical patient safety outcomes over time.

CONCLUSION

Reinforcing the importance of nurse staffing for safety, on shifts where staffing was perceived more positively, patient safety was perceived more favourably, nurses reported being more able to act as a safe practitioner, and experienced less cognitive failure. On shifts where lower patient-nurse ratios were indicated, nurses reported higher perceptions of patient safety as well as being more able to act as a safe practitioner. The findings highlight the relevance of personality in this context, particularly personality as a potential moderator

of the relationship between staffing and patient safety, opening the door for future research to build upon these findings.

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